1933

# SEALE-HAYNE AGRICULTURAL COLLEGE

NEWTON ABBOT, DEVON.

# DEPARTMENT OF PLANT PATHOLOGY

TENTH ANNUAL REPORT

FOR THE YEAR ENDING SEPTEMBER 30th, 1933.

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# SEALE-HAYNE AGRICULTURAL COLLEGE.

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## Department of Plant Pathology.

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*Advisory Entomologist :*

L. N. STANILAND, A.R.C.S., D.I.C.

*Advisory Mycologist :*

A. BEAUMONT, M.A. (Cantab.)

# Tenth Annual Report of the Department of Plant Pathology.

## ADVISORY WORK.

Statistics of advisory letters and visits are as follows:—

| *Advisory Letters.* | *Entomological.* | *Mycological.* |
|---|---|---|
| Devon ..... ..... ..... | 141 ..... | 135 |
| Cornwall ..... ..... ..... | 75 ..... | 75 |
| External ..... ..... ..... | 44 ..... | 37 |
| Total ..... ..... | 260 ..... | 247 |
| *Advisory Visits.* | | |
| Devon ..... ..... ..... | 161 ..... | 84 |
| Cornwall ..... ..... ..... | 99 ..... | 54 |
| Total ..... ..... | 260 ..... | 138 |

## LECTURES.

In the College the usual courses were given, and the Entomologist gave lectures and demonstrations at the Short Course in Beekeeping on "The Dissection of Bees for Acarine Disease." External lectures were given by the Entomologist at

| | |
|---|---|
| Dawlish ..... | Violet Aphis and Violet Eelworm. |
| Do. ..... | Bulb Pests. |
| Do. ..... | Pests of Soft Fruit. |
| Dartington | Farm Pests. |
| Totnes ..... | Science versus Practice (Debate). |
| Penzance ..... | Pests of Bulbs, Potatoes and Violets Important in the Penzance District. |
| Do. (Spring Flower Show). | Two new Pests of Violets. |

A paper on "Violet Eelworm" was given at the Advisory Entomologists' Conference in Bristol.

External lectures by the Mycologist were given at

| | |
|---|---|
| Kingsbridge ..... ..... ..... | Diseases of Farm Crops. |
| Torquay ..... ..... ..... | Flower Diseases. |
| Do. ..... ..... ..... | Daffodils. |
| Barnstaple ..... ..... ..... | do. |
| Bickington Women's Institute | Bulbs. |
| Manaton W.I. ..... ..... | do. |
| Bovey Tracey, Teign Naturalists | Fungus Foray. |

A paper on "The Measurement of Disease" was given to the British Mycological Society in London.

The Dawlish and District Growers' Association paid a visit to the College on April 27th, and made a tour of the laboratories and inspected the experiments in progress in the plots of the Department.

**SHOWS.**

Exhibits were staged at the Commercial Horticultural Shows at Penzance in March and Plymouth in April, and at the Royal Horticultural Society's Flower Show at Chelsea in May. An exhibit was also sent to the Newton Abbot Allotment Society's Show in August.

**NARCISSUS FLIES.**

A preliminary experiment on the control of Narcissus Flies was carried out in the Penzance district. The treatment consisted of a heavy dusting with a cheap dust easily made by any grower at small cost. The results were very promising. The dust was applied by means of a manure distributor during the egg laying period of the flies. If any grower would like to try this method of fly control and is prepared to make the dust and apply it on his own ground, full particulars can be obtained on application to the Advisory Entomologist. It is important that the bulbs treated should be lifted at the end of the season, in order to make it possible to examine the bulbs and thus assess the success of the method.

**HOT WATER TREATMENT OF NARCISSUS BULBS.**

Results of some of this work have been published during the year (see below under Publications) and many other data have been collected and are available to any grower on application. It is hoped it will be possible to eliminate the flower damage, which causes such great loss to the grower, by determining the suitable date and length of treatment for each variety.

**STRIPE DISEASE OF NARCISSI.**

The observations on "stripe" this season have shown the problem to be a very complex one, comprising probably more than one type of trouble. There were many cases of complete or partial recovery, particularly in varieties like King Alfred. Artificial transference of the disease has not yet been successfully carried out.

## LOGANBERRY SHOOT BORER.

An unusual pest occurred on loganberries in a plantation in South Devon during the year. The pest was a fly, the maggots of which were found tunnelling in the young canes of loganberries, and causing severe wilting of the tips of the canes accompanied by characteristic purple colouration of the shoots. This pest is being studied and the Department will be glad to hear from any grower of loganberries and raspberries (on which latter crop the pest might also appear), who finds the tips of the shoots wilting in the manner described. The pest could cause considerable losses if it became severe.

## PUBLICATIONS.

By L. N. STANILAND.

Articles on "Bulb Eelworm" and "Cabbage Root Fly" in the Seale-Hayne College Monthly Bulletin.

"The Treatment of Narcissus Bulbs with Hot Water" (Journ. Min. Agric. July, 1933, xl, no. 4, pp. 343-355).

By A. BEAUMONT.

Articles on "Broccoli Diseases" and "Tomato Diseases" in the Seale-Hayne College Monthly Bulletin.

"Symposium and Discussion on the Measurement of Disease Intensity. I. Potato Blight." (Trans. British Mycological Society, xviii., 1933, pp. 174-178).

# The Spread of Potato Eelworm in Consignments of Seed Potatoes.

Potato sickness associated with the eelworm *Heterodera Schachtii*, is present at a number of centres in both Devon and Cornwall, in gardens, allotments and on farms. Where present, potato sickness is serious and is unlikely to be eradicated unless the growing of potatoes is discontinued for some years to come. There are, however, many farms in districts, in which potato growing is important, which are not yet infected with eelworm. Growers in these areas, in common with others, buy seed potatoes from Scotland and Lincolnshire, which districts are heavily infected with eelworm. In order to ascertain whether the cysts, or resting stages of the eelworm, could travel to a fresh area in seed potatoes or in the bags in which they were contained, a number of samples were examined. The cysts were found amongst the soil and general rubbish at the bottom of the sacks ; cysts were also found embedded in soil, adhering to the seed potatoes. It is clear, therefore, that potato growers run considerable risks of importing potato eelworm with seed from infected districts. Circumstantial evidence, in connection with new cases of potato sickness in the South West, lends additional weight to the above mentioned facts. Growers should, as far as is practicable, obtain seed from farms free from potato sickness, but in view of the widespread distribution of the eelworm this is becoming increasingly difficult. Care should be taken, in removing the seed potatoes from their sacks, that soil and rubbish remains in the sacks ; the soil and rubbish should be burned. It is probable that a thorough washing of the seed in cold water, thus removing soil, would do much to remove any cysts present ; but care should be taken that the seed is well dried before being placed in the sprouting trays, and, in any case, the trays should be in a well ventilated situation so as to guard against growth of moulds.

An experiment in the hot water treatment of potato seed was carried out during the season. The variety of potato selected was Majestic. The seed was treated by means of an ordinary bulb bath. Batches of seed, equal by count and of fairly even size, were treated on January 28th, for periods of 20, 30, 60, and 90 minutes, in water kept at a constant temperature of 110 F ; the periods commenced from the time that the water in the bath regained the temperature of 110°F, after having fallen consequent

on the immersion of the potatoes. After treatment the potatoes were immediately placed in sprouting trays and the trays put into a well ventilated shed and left to sprout. An untreated batch of seed was included as control. No moulds grew and all the potatoes sprouted in a normal manner. The seed was planted on May 4th. All the potatoes grew well, but it was clear from the commencement that those treated for 20 minutes were rather more vigorous than any of the others. While the experiments were not on a large scale, nor laid out especially with a view to taking crop weights, it is of some interest that the seed treated in hot water for 20 minutes yielded almost double the weight of tubers of any of the other plants. It is proposed to carry out a further experiment on a larger scale during the coming season in order to see if this apparent stimulation by a short period of hot water treatment can again be obtained.

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# The Alternative Host Plants of the Violet Aphis

(*Myzus ornatus sp.n*)

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An article on this new Aphid pest of violets appeared in the previous Annual Report. This pest causes considerable damage to violets, the injury taking the form of severe stunting of the plants, curling and distortion of the leaves, and spotting of the petals of the flowers. It was reported in the above mentioned article that winged aphids were first seen on June 3rd of that year, and that these winged forms were flying, and obviously leaving the violet plants, towards the end of July. By the middle of August practically no aphids could be found. At that time, despite a considerable amount of searching, no alternative host plant could be discovered to which the aphids might have flown. Early in September some aphids were found on the violets, and from thence onwards their numbers slowly increased. During May, 1933, a grower in the Dawlish district wrote to say that buttercups growing close to his violets were infested with an aphis, which appeared to be identical with the species on violets. An examination of the aphids proved this to be correct. The buttercups were the Common Bulbous Buttercup (*Ranunculus bulbosus*). The aphis was also noticed to be breeding extensively on the

Common Hedge Mustard (*Sisymbrium officinale*), which is a common weed throughout the district. Buttercups and Mustard were found to be infested with the aphis at a number of centres which were visited. No egg stage was found on these two weeds, and, since no egg laying has been observed on violets, reproduction would appear to be carried on entirely by the production of living young. The aphis was found in numbers on buttercups in a garden near Newton Abbot. No violets had ever been grown in this garden or in any in the immediate vicinity so far as could be ascertained. This would suggest that the aphis may be indigenous on the above mentioned weeds and may perhaps have turned its attention to violets within recent years. The aphis has not been found as yet on wild violets.

Mr. F. Laing, of the British Museum of Natural History, writes to say that the aphis has been reported on chrysanthemums at Glasnevin, Dublin ; it was found during November, 1932.

During November, 1933, it was noticed that the violet aphis was present in numbers feeding on the petals of anemones being grown for commercial purposes in Devon and Cornwall. Another aphis (*Myzus circumflexus*) had been noted previously as causing injury to the flowers of anemone, but later examinations showed that whereas both species were present the violet species was of principal importance in this connection. The aphis causes distortion of the anemone flowers and appears to be connected with a form of " breaking " of the colour of the petals, somewhat analogous to that found in tulips.

The facts in this article are of importance to growers of both violets and anemones. It is suggested that growers endeavour to keep buttercups and hedge mustard in check as much as possible, in order to reduce the chances of reinfection of their violets and anemones. The control of the aphis is necessary on both violets and anemones if anything like reasonable freedom from infection by aphis is to be obtained on either crop. The aphis should also be watched for on chrysanthemums.

# Violet Eelworm

(*Aphelenchoides olesistus*).

Much trouble has been experienced recently in the South West with this eelworm pest of violets. While the eelworm cannot be said to be a new pest it is only recently that any appreciable losses have been experienced. The history of the pest is briefly as follows. In 1909 Schwartz found the eelworm associated with a dwarfed condition of violets in Germany. The condition of the plants took the form of a kind of gall, the surface of which was covered with small stunted leaves. In 1924 Hodson reported that eelworm had completely ruined a small patch of violets, of the variety Mrs. Lloyd George, in South Devon. Hodson did not, however, describe the exact nature of the symptoms. During November, 1932, a case of eelworm attack was investigated by the writer at Dawlish. The trouble occurred in a large patch, and several smaller ones were also seen. This case was in connection with the variety "Princess of Wales." Shortly afterwards an even more severe attack was noted on the variety Kaiser Wilhelm, near Newton Abbot, a severe loss of flowers being experienced by the grower. Since 1932 a great many cases of injury to violets by this eelworm have been examined, and it is clear that few, if any, violet beds are entirely free from infection. The trouble appears to be increasing rapidly and must clearly be regarded as one of the most important limiting factors in the culture of violets.

The eelworm is very minute, being less than 1 mm. in length; apart from a slight size difference there appear to be no means of distinguishing the eelworm from those found in certain ferns, but whether individuals from ferns will attack violets is not yet known. The writer is closely associated with Dr. T. Goodey, of the Institute of Plant Parasitology, in the investigations on this eelworm.

The symptoms of attack, so far as they have been observed in the South West since 1932, have differed from those described by Schwartz in Germany. No galled condition has been observed. Whereas the symptoms described by Schwartz are analogous to those of strawberry plants suffering from "cauliflower disease," the condition observed by the writer shows strong affinity with that of "red-plant" of strawberry. The attacked plants are much dwarfed, the leaves are small and deformed, and the leaf stalks tapered, without hairs and thickened slightly (see Fig 1); the

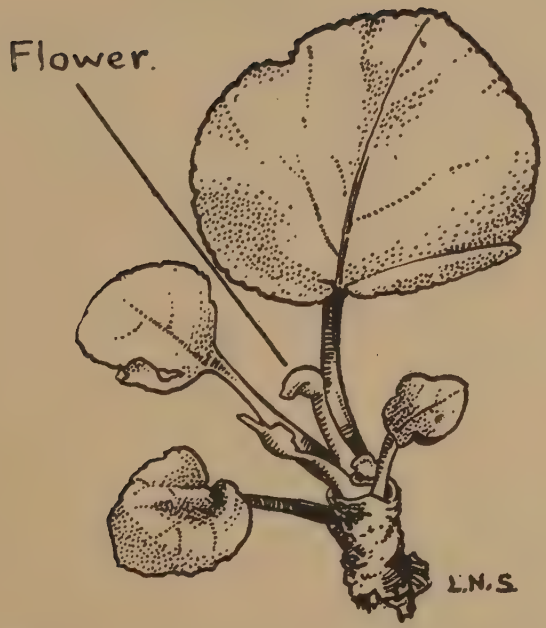


**FIG 1.**

Violet Plant severely attacked by Eelworm (**Aphelenchoides** olesistus). The sketch is about three times **natural size.**

leaf stalks also have a characteristic tendency to curve outwards and downwards. The flower stems are also short and the flowers weak. In very severe cases the leaves are very small or absent, only the leaf stalks remaining, and flowers may also be absent. The runners from affected plants frequently develop the same symptoms, often before the runner has rooted. No red pigmentation is developed such as occurs in strawberry varieties like Royal Sovereign, the symptoms being more analogous with "red-plant" in varieties like Sir Joseph Paxton. It has been found that eelworm symptoms in violets make their appearance about the commencement of the flowering season, i.e., in September and October. Whereas Schwartz found the eelworms present inside the tissues of violet plants, this does not appear to apply to plants in this country. In all cases examined by the writer the worms are to be found in leaf axils, and between the developing leaves, as in the case of eelworm in strawberries. The eelworm appears, therefore, to be ecto-parasitic and not endo-parasitic. Eelworm attacks have been observed on a number of varieties including several double kinds. In general two year old plants appear to suffer more than one year old plants, and the trouble is more often experienced when violets have been grown on the same land for several years continuously, though no direct evidence of infection of the soil by eelworm is as yet available.

Preliminary experiments on the control of this trouble have been carried out at this College and a number of suggestions arising from this work can be made. It is probably the best practice to take up and burn affected plants when these occur in well defined patches, or when the number of such plants is relatively small. Care in the selection of plants for propagation purposes is essential; only healthy runners arising from healthy parent plants should be taken. Since runners are often taken in September and laid in beds, until they are planted in their final situation in March, it is advisable to go through these runners carefully at planting time; whilst the runners may appear healthy in September, the symptoms frequently appear later on. For this reason it is best to make March the main season for runner selection, as, by this time, the parent plants will have developed eelworm symptoms; chances of effective selection are greatly increased. Every effort should be made to change the ground in which the violets are grown, so that violets do not follow violets during two successive years.

The hot water treatment of runners offers a likely means of freeing plants from eelworm. During the third week of April, 1933, a number of batches of runners (varieties Princess of Wales and Kaiser Wilhelm), some affected with eelworm and the rest

apparently free, were treated in hot water at 110°F. for varying periods, by means of a bulb bath. After treatment the runners were plunged in cold water and then planted. Control lots of runners were left untreated. Whilst further work is required, before definite recommendations can be made, it is of considerable interest that all the control series of runners developed marked eelworm symptoms and also most of those treated with hot water. The series treated for 30 minutes at 110°F. were the only plants which remained healthy. Eelworm affected runners stood the hot water treatment very badly, but healthy runners grew well. In both cases much of the older leaf was destroyed, but young leaves soon grew in their place. Further experiments on the hot water treatment of violet runners are in progress.

# Notes on Hot Water Treatment of Strawberry Runners.

A short account of preliminary experiments in the hot water treatment of strawberry runners has already appeared in the Seventh Annual Report. It is of considerable interest that the plants hot water treated at that time (for 20 and 30 minutes at 110°F.) are still healthy and have cropped well and consistently. It should be mentioned, however, that the plants, subsequent to hot water treatment, have become infected with Aphis and Red Spider at various times and that the continued health of the plants has only been maintained by suitable spraying operations. This article deals briefly with the results obtained in experiments carried out during 1932 and 1933.

**METHOD OF TREATING.**

Runners have been subjected to treatment in a thermostatically controlled bath, heated by means of electricity, and also in an oil heated bulb bath of larger capacity. A number of batches of runners have also been treated in a bucket heated by means of an ordinary gas burner, in order to see to what extent growers may successfully treat runners where no thermostatically controlled apparatus is available. Good results were obtained with all these types of apparatus, and it is clear that growers can successfully treat runners by the more primitive means, provided

that they are prepared to spend the necessary time carefully watching and regulating the temperature. Instances are known where growers have attempted to treat runners in hot water without a thermometer, but this instrument is, needless to say, essential.

The bath should be provided with some form of grid to keep the runners from coming into direct contact with the bottom, and so prevent them from overheating. Alternatively, the runners may be enclosed in a wire cage standing on short legs. Where a large bath is used the runners may be placed in sprout or cabbage nets, but a grid should be present at the bottom of the bath.

Since a large proportion of the soil adhering to the runners is removed by the hot water treatment, it is best to wash the runners in cold water before treatment and so prevent the accumulation of soil at the bottom of the bath, otherwise the even heating is often adversely affected.

If runners are being treated in water at a temperature of 110°F. the water in the bath should be raised to such a temperature that, when the runners are immersed, the temperature will fall to 110°F., but the exact starting temperature of the water can only be found for each individual bath by trial. The period of treatment commences when the water is steady at 110°F. As soon as the treatment is completed, the runners are taken out and immediately plunged into cold water, in order to cool them quickly. The runners should then be planted out at once. Runners should not therefore be treated at a greater rate than the planters can deal with them, though runners may safely be 'heeled in' until they are planted into their permanent quarters.

## EFFECT OF TEMPERATURE OF WATER AND DURATION OF TREATMENT ON RUNNERS (1932).

Runners were successfully treated for periods of 15, 20 and 30 minutes at a temperature of 110°F. Treatment at a temperature of 118°F. for 10 minutes is recommended in America. Good results were obtained with this treatment where planting conditions were really good and when the runners treated were vigorous, but otherwise the loss of the plants so treated was rather heavy.

## DATES OF TREATMENT IN RELATION TO CONDITIONS OF RUNNERS (1932-33).

During 1932 runners were treated for all the periods mentioned on August 5th, and in 1933 on March 15th. Each batch of runners (twenty in number) on being taken out of the bath, was divided into two portions; one half was treated with cold water, while the remainder were allowed to cool slowly. A con-

trol batch of runners was planted at each of the dates and the soil was washed off the roots of these runners by means of cold water.

The runners were all of the variety Royal Sovereign, and were all mostly infected with Tarsonemus Mites and Strawberry Aphis.

The best batch of runners was a control series planted on September 1st, 1932, but results very nearly as good, with due allowance for the date of planting, were obtained by all the treatments tested. Those batches treated at 118°F. for 10 minutes were only good when treated during August and September. Good results were obtained with a temperature of 110°F. at all the dates when the duration of treatment was 15 or 20 minutes, but when the length of treatment was 30 minutes the loss of plants was somewhat greater when planting conditions were not good. When planting conditions were good the loss of plants was never severe. Some loss of plants occurred in all the control batches.

## EFFECT OF TREATMENT WITH COLD WATER AFTER THE REMOVAL OF THE RUNNERS FROM THE BATH (1932-33).

On the whole, those runners which received treatment with cold water, immediately after removal from the bath, were markedly better than those which were allowed to cool slowly. The plants held their older leaves better after treatment and tended to grow away better. Later on in the season the differences were not so marked, but those which received cold water treatment were still rather better. Such cold water treatment is particularly important where large batches of runners are treated.

## THE EFFECT OF TREATMENTS ON PESTS.

(a). **Tarsonemus Mite.** (*Tarsonemus fragariae*).

It was found that all the treatments with hot water killed Tarsonemus Mites. Subsequent examinations of the plants at intervals showed that the eggs of the mites were also killed, since mites did not again develop. Small batches of Mite infested runners were treated for periods of 5 and 10 minutes. Very few mites were killed after 5 minutes, but in the case of 10 minute treatments the percentage was much higher, though some still survived. The very short treatments described above were not tested against any other pests.

(b). **Strawberry Aphis.** (*Capitophorus fragariae*).

Aphids were satisfactorily controlled by all treatments.

(c). **Strawberry Eelworm.** (*Aphelenchoides fragariae*).

While no " Red Plant " or " Cauliflower " disease developed in any of the plants, treated or untreated, examination of treated plants showed that some eelworms survived in plants treated for 15 and 20 minutes. Other work on this aspect of the problem suggests that treatments of 20 minutes at 110°F. may be satisfactory in the case of very small runners provided that the number of runners treated at once is relatively small. Otherwise it would appear likely that 30 minute treatments are preferable, always providing that planting conditions at the time of treatment are good. Determinations of the time taken to kill the eelworms in water at a temperature of 110°F. and of the time taken for heat to penetrate to the growing point region of strawberry runners of various sizes support the above mentioned observations.

**TREATMENTS DURING 1933.**

Runners of the variety Royal Sovereign were treated on April 5th for 20 minutes at a temperature of 110°F. The runners were treated with cold water after removal from the bath and planted immediately. Untreated runners were washed in cold water and also planted. The loss of plants was only slightly higher in the case of the treated runners than in the control. No mites or aphids were present on these runners, which were from plants hot water treated during the previous year. Examinations of sample plants failed to bring to light any live Strawberry Eelworms, and up to the present the plants remain healthy and have grown satisfactorily.

The experiments suggest that where only Tarsonemus Mites and Strawberry Aphis are present runners may be treated for 15 minutes at a temperature of 110°F. Where large numbers of runners are treated together in a bath it is likely that better results will be obtained if the duration of treatment is extended to 20 minutes. No observations on the effect of hot water treatments on Red Spider have been made at this College, but it is probably safe to assume that 20 minute treatments are ample. Where " Red Plant " and " Cauliflower " disease are particularly giving trouble to the grower, it would seem advisable, so long as planting conditions are good, to treat the plants for 30 minutes, unless the runners are small and treated in small batches.

# Narcissus Disease and Pest Control Calendar.

## JANUARY.

Where land is eelworm infected, and therefore growing a crop other than narcissus, volunteer plants of narcissus should be lifted. The rest period of three years for the land cannot safely be said to have commenced until all narcissus bulbs are out of the ground.

In the greenhouse inspect forced narcissus bulbs for eelworm in the form of leaf lesions, or " spickles " ; also examine for damage by the Bulb Scale Mite and by slugs. If necessary control slugs by means of a Paris Green and bran poison bait, made as follows : 20 lbs. of broad bran are mixed dry with 1 lb. of Paris Green (poisonous). About 1 gallon of water is then stirred in so as just to moisten the mixture. Broadcast sparingly throughout the house and amongst the bulbs. Follow if required with a second dressing a week later.

Tar oil spraying on fruit trees under which narcissus bulbs are growing should be completed by the end of this month. The young shoots should in any case be washed with water immediately after spraying, before the spray has dried on the foliage, in order still further to lessen chances of causing damage.

Varieties susceptible to Leaf Scorch (*Stagonospora Curtisii*) will already show a considerable amount of this fungus, for example, Medusa. It may also be serious on third year beds of Sol d' Or. The brown tips are often mistaken for frost damage by growers. If the attack is severe it is worth while to cut off the brown areas with scissors, in order to prevent the danger of flower damage later on.

## FEBRUARY.

Lift the remainder of the narcissus volunteer plants (see January).

Inspect the growing crops for the presence of " Spickles " and also for dwarfed, distorted, yellow foliage and flower stems, due to infection by eelworm. Mark by means of stakes, or otherwise note, the situation and extent of such eelworm infections. When only a few plants are infected it is advisable to remove them now. Look out also for yellowish distorted foliage, or weak grass-like foliage, indicating the presence of bulbs attacked by the larvae of bulb flies.

Carry out cultivations to keep weeds down to assist in the control of eelworm. The various species of plantain are especially

important since the strain of eelworm present in these weeds is able to attack narcissus. Other important weeds are the False Dandelion and Hawkweed. Cultivate eelworm infected ground last of all and clean and disinfect all implements before resuming work on healthy bulbs. Walking on infected areas should be avoided as much as possible.

Clean cultivation will also promote the healthy growth of the plants and make the conditions less favourable for the spread of fungal diseases than they are in a weedy bed. The great harm done by weeds in keeping the air moist near the ground is not generally realised, and as fungi depend on a moist atmosphere for their development, the presence of weeds greatly assists them. It is also more difficult to make spraying effective if weeds are abundant. The measures taken against Leaf Scorch in January will have to be repeated this month. Poeticus varieties like Horace will need attention in particular, as they are very liable to flower damage from this fungus. If the area is too large for cutting to be practicable concentrate on some of the worst spots and examine the ground carefully to see if the amounts of the disease are connected with the drainage. This is often the case, the disease being generally the worst in wet patches. Drainage must either be improved or only resistant varieties grown in the affected area. The spraying recommended below against White Mould will have very little effect on Leaf Scorch at this stage.

White Mould (*Ramularia Vallisumbrosae*), often called "Fire" by growers, frequently appears this month in West Cornwall. Spraying should be commenced before the disease appears or immediately after the flowers have been picked. Complete control cannot be expected but the amount of premature leaf decay will be reduced and the resulting bulb crop therefore will benefit. The best spray to use is Bordeaux mixture (4lb. copper sulphate and 2 lb. lime in 40 gallons of water) with an efficient wetting agent, $\frac{1}{2}$lb. in 100 gallons. Spraying will probably not be necessary in Devon until April. Cutting, as recommended against Leaf Scorch, is effective, but the disease is usually too extensive for this operation to be practicable.

Narcissus Grey Mould (*Botrytis narcissicola*) will be frequent and the beds must be examined once a week for its presence. It can be recognised readily by the grey mould present on decayed areas on the leaves usually near the surface of the soil. It does not do much damage except that on some varieties it can get down into the bulb where it forms its black resting bodies. The prompt removal of decayed leaves will prevent this. The fungus grows most readily on injured leaves and care must be taken in hoeing not to damage the leaves.

## MARCH

The operations described for the month of February should be continued. Cutting Leaf Scorch tips in susceptible varieties is very important, and another spraying should be given against White Mould unless the weather is cold and dry. Removal of Grey Mould leaves is as important as in February. Before flower picking makes the grower too busy the plants should be inspected for Stripe and their condition noted. In the present state of our knowledge it is impossible to give any definite recommendations for the control of stripe. The grower must make his own decisions what to do with the bulbs, as the value of the stock and the extent of the trouble have to be considered. Probably the safest plan is to lift the worst stocks at the normal time and plant them if they are worth preserving in a field isolated from the rest of the farm. If the stocks are not of high value they should be destroyed.

## APRIL.

Flower picking this month usually takes up most of the time, but if the opportunity can be found another spraying against White Mould should be given. This will also benefit the plants in combating the other fungal diseases, all of which can now cause premature leaf decay. All examinations for the presence of Stripe and eelworm must be completed this month.

Flower Spot is often a serious trouble and great care must be taken not to pick blooms showing this blemish, as it will grow worse very rapidly in the boxes. The fungi *Stagonospora Curtisii* and *Botrytis narcissicola* are responsible, together with moist weather which enables them to be active. The control measures already carried out should reduce it to a minimum.

## MAY.

Remove any screens around bulbs as soon as flowering is completed, so as to take away shelter for Bulb Flies.

Varieties on which the foliage remains green for a long period may be earthed up in order to reduce the chances of access to the bulbs by larvae of Bulb Flies. Where heavy fly attacks are ikely the foliage may be cut off about three inches above soil level and the whole earthed over. Later on such beds may be raked down.

Rake down beds as soon as possible (i.e., when the foliage is about two-thirds yellow) so as to fill up the holes in the soil leading to the bulbs; this will prevent the laying of the eggs of flies and the access of larvae to the bulbs.

Burn all foliage which has been raked off eelworm infected bulbs. Place horizontal screens of Hessian canvas at a height of

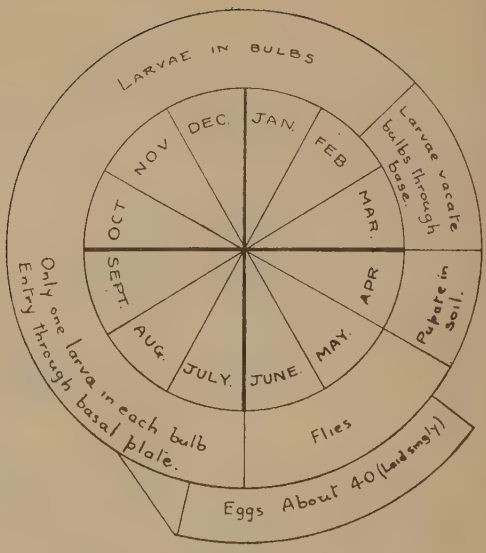


**FIG 2.**

Diagram of the Life History of the Greater Narcissus Fly (Merodon equestris).

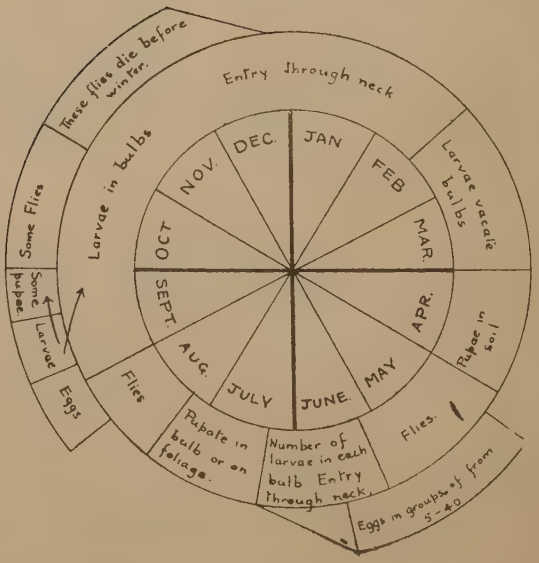


**FIG 3.**

Diagram of the Life History of the Lesser Narcissus Flies (Eumerus spp).

about 4 feet, over beds of valuable bulbs in order to prevent egg laying by flies; flies will not lay eggs in the shade.

Commence poison bait spraying for Narcissus flies (see diagrams of life histories Figs 2 and 3). The formula for the spray is as follows:

| | |
|---|---|
| Sodium Arsenite (highly poisonous) | 4 oz. |
| Crude Glycerine | 1 lb. |
| White Cane Sugar | 2 lbs. |
| Water | 4 gallons |

Use 8-10 gallons of spray per acre, applying with a coarse nozzle at low pressure (an ordinary garden syringe is quite satisfactory). The object is to apply the spray so that the liquid forms in large drops on the foliage. The flies feed on the drops of liquid and are poisoned. Hedges around the bulbs should also be treated and the whole of the spraying should be carried out in warm sunny weather.

Times of spraying in this month are:—

*1st Spray*. About May 15th. *2nd Spray*. About May 25th.

Another spraying with Bordeaux mixture against White Mould may be advisable on the late varieties such as Recurvus and Double White. Varieties in which the foliage is dying down, e.g., Golden Spur in West Cornwall, will have abundant resting bodies of the fungus in their yellowing leaves. These leaves should be raked off and burned as promptly as possible. The cutting off early, as recommended against Fly will be helpful in this connection. The foliage should not be burned over the bulb beds, as the bulbs underneath may be injured. If the leaves are allowed to rot into the soil the latter becomes infected with the White Mould fungus and epidemics will tend to increase in severity in subsequent seasons. The removal of the foliage will also tend to check the perpetuation of the other fungi including Leaf Scorch, Grey Mould and *Botrytis polyblastis* (see Sixth Annual Report), all of which pass into the bulb in this month.

## JUNE.

Continue poison bait spraying.

*3rd Spray*. About June 4th. *4th Spray*. About June 14th. *5th Spray*. About June 24th.

Hot water treat bulbs which have been forced, as soon as the boxes have dried out. Burn the boxes or sterilise them in water at a temperature of not less than 150°F., or by means of formalin. Either sterilise the soil in the boxes by means of heat or dispose of the soil in such a way that it will not again come into contact with bulbs.

Begin lifting bulbs. Lift eelworm affected stocks first. Clean the bulbs roughly and put in trays in well ventilated sheds. If the bulbs are first left out of doors to ripen, they should be covered over in order to keep them shaded and so prevent the laying of eggs on them by bulb flies.

The proper ripening of bulbs is a skilful job requiring much experience. The practice of ripening in the sun is probably beneficial to some Trumpet varieties, but is very risky unless carried out with care. The safest plan is probably to put the bulbs in trays immediately and go over them carefully when cleaning. Where sufficient trays are not available great care should be taken not to store them in too thick a layer and the store must be kept cool.

Continue the raking down of all beds not ready for lifting. Burn the foliage as rapidly as possible as recommended for May.

Bulbs which have been in the ground the largest number of years will be ready for lifting first. From the point of view of both insect and fungus pests frequent lifting is advisable, and no beds should be left down longer than three years.

## JULY.

Finish poison bait spraying: *6th Spray*. About July 3rd.

Continue raking beds and lifting bulbs.

Examine bulbs in store removing all bulbs which are soft as the result of attacks by eelworm, Bulb Mites, Bulb Scale Mites and Fungal Rot.

Grading will be carried out at the same time. Afterwards the bulbs should be put back in trays (which are reasonably clean) and kept in cool store till they are ready for hot water treatment. This will be started this month in West Cornwall with certain early varieties (e.g., Polyanthus kinds), but in other parts of Devon and Cornwall the treatment cannot be started till next month. Short treatment (1 hour) for Fly and Bulb Scale Mite may be carried out and will ease the pressure of work in August.

## AUGUST.

During this month all bulb lifting should have been completed.

Continue the hot water treatment of bulbs for eelworm, bulb flies and mites. Sort out all soft bulbs prior to treatment, unless the stock is valuable, in which case soft bulbs may be treated and planted out separately. Treat eelworm infected stocks first.

All bulbs should be placed after treatment in trays, which have been sterilised with hot water at 150°F., or by means of formalin.

Where no eelworm is present, but the bulbs are attacked by narcissus flies, fumigation treatment with paradichlorbenzene may take the place of hot water. Fumigation is carried out in an air-tight container using 4 oz. of the fumigant to every cubic foot of space. Fumigation is carried out for 120 hours, and the chemical must not come into actual contact with the bulbs.

Examine bulbs in store from time to time. Grading should be completed before hot water treatment is begun. Stocks which do not require hot water treatment should be examined and graded in a different shed, so as to avoid the danger of contamination.

It is well known that the standard 3 hour treatment in hot water usually reduces the flower crop the next season either by damaging the flowers or preventing them developing. The amount and nature of the damage depends on the variety and on the date of treatment. If bulbs are treated too early the flower appears next season, but is damaged, i.e., the perianth segments are chipped or notched, and the corona is split. If the date of treatment is late the leaves are marked and the bulbs fail to develop any flowers, or the buds formed are blind. A number of flowers may be formed, but are usually below normal in size and quality. There is a period between these dates when the loss sustained is at a minimum, and it is obviously desirable that heat treatment should be carried out during this "safe period."

The dates of the "safe period" depend on the time the leaves died down and the bulbs became dormant. It is earliest for bulbs from Scilly and West Cornwall where the leaves die down early. Devon and East Cornwall are a week or two later, and bulbs from Holland, North Ireland and Scotland are later still. As far as our experience goes the "safe periods" are as follows :—

| | |
|---|---|
| Scilly and West Cornwall | Aug. 12th to Aug. 22nd. |
| Devon and East Cornwall. | Aug. 20th to Aug. 31st. |
| Holland and Lincs. | Aug. 25th to Sept. 3rd. |

The above dates must be regarded as only approximate, as varieties vary in their susceptibility to damage and there will be a small variation with the season. Some varieties stand hot water treatment well and may be safely treated over a somewhat longer period, e.g., for Henry Irving and Princeps it may begin somewhat earlier; while Golden Spur, Macebearer, Emperor, Sunrise, Firetail, Helios, Croesus, Empress may be treated later.

On the other hand, the safe period may only be a few days in the middle or end of the above dates, e.g., King Alfred, Victoria, and Lucifer.

For a few varieties there is no "safe period," e.g. Ornatus Maximus and Double White. These are all kinds with small bulbs and a shorter treatment than 3 hours is recommended for these (see paper by L. N. Staniland, referred to on p. 4).

Satisfactory results also cannot be guaranteed with the Polyanthus and Leedsii groups, but it will be found that the damage is least during the safe period, though not entirely eliminated.

The use of a disinfectant in the bulb bath is becoming popular with growers. The proprietary mercury compounds now available are very efficient and do no damage to the bulbs. Formalin is cheaper and still more effective, but sometimes adds to the danger of flower damage. Neither substance is necessary where the bulbs being treated have been cleaned and graded, (all soft ones being rejected) and where it is possible to store the bulbs in trays after treatment. This is not always practicable on a commercial scale, and the bulbs are often mixed up with much damaged tissue and are very slow in drying even in trays, while in bags or layers the conditions are exceedingly favourable for the rapid spread of fungal decay. The Trumpet varieties are particularly susceptible, and for these it is recommended that the bath contains 1 pint formalin in 50 gallons of the liquid. No disinfectant is recommended for the Poeticus group.

**SEPTEMBER.**

Hot water treatment of bulbs should be finished by the end of this month. Hot water treat all bulbs bought in before they are planted. It is very difficult to guarantee bulbs to be entirely free from eelworm, and so it is unwise not to take the precaution of treating all purchased bulbs before planting, even if this means the loss of the first flower crop. Flower loss need not be great (i.e., less than 20%) with most kinds. For example, Ornatus, Irving, Princeps, Sunrise, Firetail, Helios, Croesus, Emperor and Brilliancy can be treated this month with quite good results.

Plant bulbs back on soil free from eelworm infection. (If this cannot be avoided plant infected land last of all, and lift the bulbs as early as possible the following season and treat them with hot water). Soil infected with eelworm should not be planted with narcissus or onions if this can possibly be avoided. It may prove to be advisable to include Iris in this category. Weeds should be kept down, particularly plantain (see February). Soil lower down a slope should be regarded with great suspicion, and should not be planted with narcissus if this can be avoided. Any land which receives draining of water from infected land should also be similarly regarded.

It is important to consider the previous crop when arranging the planting. Daffodils do best after potatoes, and it is better to follow a different crop, e.g., tulips, than to follow daffodils. Where this is not practicable the variety planted should be as different as possible from the one previously occupying the site.

For example, Golden Spur would much better be planted after Ornatus than after King Alfred, and Ornatus should follow Henry Irving rather than Horace. This is chiefly important from the point of view of controlling fungal disease,and a variety like Horace which is very susceptible to *Ramularia Vallisumbrosae*, should be followed by a resistant kind, such as Irving, Princeps, or King Alfred, and not by a susceptible variety such as Golden Spur or Poeticus Recurvus. In this way such fungi are prevented from establishing themselves on an epidemic scale.

## OCTOBER.

All planting should be finished during this month.

Carry out cultivations to keep down weeds.

Hot water treat all purchased bulbs even though it is known that the flower crop will be reduced.

The hot water treatment of the grower's own stock should have been completed in September. Late treatment injures the roots,and this may do serious damage to a variety like Golden Spur, or Sir Watkin. On the other hand, some kinds such as Sunrise or Ornatus are often stimulated to earlier flowering, but the general growth of the plant is weakened as compared with untreated plants or with plants treated in August. The damage becomes more severe the later the date of treatment ; November treated plants may die out altogether.

## NOVEMBER AND DECEMBER.

Clean out bulb store ; wash store, shelving, etc., with Cresylic acid or Formalin.

Make the first inspections of forced bulbs for eelworm and other pests.

Especially observe drainage in relation to narcissus cultivation and eelworm.

# Notes on Pests during the Year.

**CEREALS.**

With the exception of slugs, which have been serious in some districts during the wetter portions of the year, no serious pests of cereals have been brought to the notice of the Adviser. A case of Stem Eelworm (*Anguillulina dipsaci*) occurred on oats in North Devon.

**POTATOES.**

Potato Sickness (*Heterodera schachtii*) is spreading at a rate which can only be described as alarming. A number of fresh centres of infection has occurred in various parts of the province, though the majority of such fresh centres are on allotments. There has been no serious spread in the early potato growing areas in West Cornwall, though the areas infected in previous years continue to suffer severely.

**ROOT CROPS.**

A few isolated cases of Mangold Fly (*Pegomyia betae*) occurred in North Devon, but this pest was of little importance generally.

Cutworm damage (*Agrotis spp.*, etc.) was again extensive and even more severe than during the previous season.

**BRASSICAE.**

Cabbage Root Fly (*Chortophila brassicae*) was definitely far less serious than in the previous year. Cutworms, however, caused serious injury, particularly to broccoli, in many districts.

Attacks of the Cabbage White Fly (*Aleurodes brassicae*) were numerous, particularly on Brussels Sprouts, in North and South Devon. It is of interest that only one case of such an attack was noted last year.

Whilst some damage occurred to seedling broccoli from attacks of the Turnip Seed Weevil (*Ceuthorrhynchus assimilis*), the bulk of the damage to this crop was due to attacks by Blossom Beetles (*Melegethes aeneus*). In some cases up to 15 per cent. loss of seed was experienced. Caterpillar attacks (*Pieris spp.*) were very severe in West Cornwall. Ox cabbage in the Launceston area has been much attacked by cabbage Gall Weevil (*Ceuthorrhynchus pleurostigma*).

**PULSE.**

Peas suffered from attacks by the Pea Thrips (*Frankliniella robusta*). Bean Aphis (*Aphis rumicis*) was again not severe.

**OTHER VEGETABLES.**

Cutworm injury (*Agrotis* spp., etc.), was very severe on lettuce in West Cornwall and parts of Devon. Several cases of Tomato Eelworm (*Heterodera marioni*) occurred in Devon. Mushrooms were attacked by the Mushroom Mite (*Tyroglyphus mycophagus*) in the Truro district.

**FRUIT.**

With a few exceptions, pests of top fruit were of normal occurrence. Woolly Aphis (*Eriosoma lanigerum*) was particularly severe. Aphids were of general occurrence where no spraying was carried out, but these pests were nowhere very serious.

The Raspberry Shoot Moth (*Incurvaria rubiella*) was serious at several centres in South Devon and seems to be increasing.

A pest of especial interest occurred on loganberries in the Dawlish area (South Devon). The pest has not yet been identified, but would appear to be the Raspberry Cane Borer, such as is found in America. Records have come to light which show that this pest has occurred some years previously in the East of England, but whether it is an indigenous insect of infrequent appearance, or whether the cases are due to importation from abroad, is uncertain. The grower has, with the help of the Adviser, made an attempt to eradicate the pest by the cutting out and destruction of affected canes.

An attack of the Raspberry Leaf Mining Sawfly (*Fenusa pumilio*) took place on raspberries in the Barnstaple district. It is unusual for this pest to occur in such numbers as in this case.

Strawberries were severely attacked by the Strawberry Aphis (*Capitophorus fragariae*) which was very prevalent on the varieties Leader and Mdme. Kooi in North Devon. The variety Royal Sovereign was severely attacked by Red Spider (*Tetranychus telarius*) and the Strawberry Mite (*Tarsonemus fragariae*). In South Devon the principal troubles were these two latter pests, though aphis occurred in the Dawlish area.

**FLOWERS.**

Damage to Narcissus bulbs by eelworm (*Anguillulina dipsaci*) and by Narcissus flies (*Merodon* and *Eumerus*) has been of normal intensity. Observations made throughout the year have shown the Bulb Scale Mite (*Tarsonemus approximatus*, var. *narcissi*) to be of widespread occurrence. Losses to growers from attacks by this pest have been observed, particularly in the case of bulbs which have been forced under glass. Anemones have suffered from attacks by Aphids (*Myzus circumflexus* and *M. ornatus*), many flowers being distorted and rendered unfit for market. Cutworm damage (*Agrotis* spp.) has also

been very severe, and many pieces grown from seed have had to be replanted with corms. In the Penzance area, Springtails (*Sminthurus viridis*) were very common amongst anemone seedlings; the springtails caused a certain amount of damage by feeding around the base of the leaf stalks. Violets were attacked by a pest discovered in the province during the course of the year, viz., eelworm (*Aphelenchoides olesistus*). Severe losses were experienced in both counties, and the trouble was found to be widespread. A leaf curling midge (*Dasyneura affinis*) was found attacking violets in the Falmouth area. Red Spider (*Tetranychus telarius*) was exceptionally common and widely distributed on violets, and the year was one of the worst on record for this pest. Aphis attacks (*Myzus ornatus*) were at first serious, but with the advent of dry conditions, the pest was replaced by Red Spider. Chrysanthemums were attacked by Earwigs and also by the root feeding larvae of a fly (*Psila nigricornis*). Eelworm (*Aphelenchoides ritzema-bosi*) was found in several districts, and may be expected to spread unless due precautions are taken by growers. Tulip bulbs were eaten by rats in West Cornwall, the bulbs being pulled out of the soil after planting. Phlox in several districts was found to be attacked by eelworm (*Anguillulina dipsaci*). The Rhododendron Bug (*Leptobyrsa rhododendri*) was found in South Devon at two centres.

**BEES.**

Acarine Disease of Bees (*Acaraphis woodi*) was again markedly slight, and very few of the samples of bees sent in for examination were found to be infected.

# Pests reported from Devon and Cornwall.

This list comprises those insects not reported in the nine previous years and those occurring on host plants previously unrecorded.

| Pest. | Crop. | Remarks. |
|---|---|---|
| | **FRUIT.** | |
| *Diptera.* | | |
| *Phorbia* sp. | Loganberry. | This pest is similar to the Cane Boring Maggot of America, but the exact species has not yet been determined. The young canes are tunnelled. An attack occurred in South Devon. |
| | **FLOWERS.** | |
| *Collembola.* | | |
| *Sminthurus viridis* (L.) | Anemone. | Some damage caused to seedling anemones in the Penzance area, by these spring tails. |
| *Rhynchota.* | | |
| *Leptobyrsa rhododendri* (Horv.) | Rhododendron. | The Rhododendron Bug occurred at Chudleigh and near Exeter. |
| *Myzus ornatus* (Laing). | Anemone. | Found to be feeding in the flowers of Anemone in Devon and Cornwall. |
| | Hedge Mustard. Bulbous Buttercup. | These two common weeds have been found to be alternative host plants for the Violet Aphis. |

| | | |
|---|---|---|
| *Lepidoptera.* | | |
| *Agrotis* sp. | Anemone. | Cutworm damage has been severe on anemones in Devon and Cornwall. |
| *Diptera.* | | |
| *Dasyneura affinis* (Kieff). | Violet. | Considerable damage occurred near Falmouth. |
| *Psila nigricornis* (Meig.) | Chrysanthemum. | Severe damage by the larvae of this fly near Newton Abbot. |
| *Chortophila brassicae* (Bche.) | Stock. | Noted in West Cornwall. |
| *Nematoda.* | | |
| *Aphelenchoides olesistus* (Rit. Bos.) | Violet. | Severe and widespread throughout Devon and Cornwall. The damage has developed rapidly, and seriously endangers the Violet growing industry |

**MISCELLANEOUS.**

| | | |
|---|---|---|
| *Acarina.* | | |
| *Tyroglyphus mycophagus* (Mégnin.) | Mushroom. | On mushrooms in West Cornwall. |

# Notes on Fungal Diseases during the Year.

The season was unusually favourable to the healthy growth of crops. Flowers and farm crops were good and harvested under favourable conditions. There was much dry warm weather, but no real shortage or rain, except perhaps in August. A dry August, however, is valuable as a rule, giving a good harvest and freedom from fungal diseases, e.g., Potato Blight. On the whole, then, losses from disease were exceptionally small. No doubt correlated with this is the unusually low average daily humidity experienced right through the year.

The satisfactory distribution of the rainfall is shown by the following table :—

**RAINFALL AT SEALE-HAYNE COLLEGE, 1933.**

| | | | |
|---|---|---|---|
| February | 4.21 in. | June | 2.38 in. |
| March | 3.99 | July | 2.29 |
| April | 2.58 | August | 1.79 |
| May | 2.33 | September | 3.12 |

**CEREALS.**

Rusts were very scarce, only Brown Rusts being observed at the end of the summer ; they did no damage. Smuts were probably below normal. Leaf Spot of Oats was much less common than last year. Mildew did some damage to Victor wheat in the early spring at Newton Abbot. Glume Blotch was reported on wheat near Exeter.

**POTATOES.**

Blight appeared in West Cornwall on May 7th and spread during the next few days, but was then checked by hot, dry weather. The crop was lifted with very little loss There was a local outbreak in a garden at Braunton on May 19th on the variety Field Marshal (saved seed). The plants were destroyed. Main crop varieties were first attacked in Cornwall on June 16th, and the disease spread rapidly in July. Near Plymouth the first outbreak began July 15th, at Brixham July 20th, and at Seale-Hayne July 29th. In the Moretonhampstead district several outbreaks began at the end of July. There was a local outbreak on Sharpe's Express near Bridford, June 30th (the local conditions being very

favourable), but main crop varieties only just began to show the disease on July 15th. More dusting than before was carried out in this area and checked the progress of the disease. Crops were generally good and showed very little disease in Devon, but there was a moderate amount in Cornwall.

Black Leg was rather commoner than usual. The Barnstaple area seems every year to be particularly liable to Powdery Scab. Analyses from this and other areas where Powdery Scab and Common Scab occurred showed in every case a high lime content in the soil (e.g., pH 7.43, 7.70 and 8.01).

Leaf Roll occurs in crops from once-grown seed in the Chagford area, but is very slight.

**ROOT CROPS.**

There were a few cases of Black Leg in Mangold and Sugar Beet in Cornwall, but the plants recovered later so that quite satisfactory crops were obtained. The disease was very scarce in Devon and caused no loss. Mangold Rust was present in September, but was very slight. Heart Rot occurred on a few farms in Devon, but only small patches were badly affected. Analyses of the soil at one farm showed a larger potash content in the diseased patches than elsewhere.

Finger and Toe was prevalent on swedes and turnips, but was not above normal. A disquieting feature was the presence of the disease on Bruce turnip and Balmoral swede which have hitherto proved resistant. Mildew was common in Devon, but had no appreciable effect on the crop. Soft Rot was not observed. There was a case of serious loss to 2 acres of swedes in South Devon, caused by Dry Rot (*Phoma Lingam*) in a field which had never grown swedes before; the crop appeared quite healthy until after Christmas.

**BEANS.**

There were only two cases of Chocolate Spot, both on small plots in market gardens. Both soils were deficient in potash, and in one case an attempt had been made to correct the deficiency by an application of 8 cwt. per acre of sulphate of potash before sowing, but no control was obtained. It is probably difficult to build up the potash content of the soil adequately in one season.

**VEGETABLES.**

Tomato troubles were frequent, but crops were generally good. Leaf Mould appeared in Cornwall about May 25th and in Devon at the beginning of June. There were more complaints than usual from Cornwall, but the disease was below normal in Devon. Blossom End Rot was especially frequent in June and

July, growers failing to allow for the hot weather making necessary more heavy watering than usual. Foot Rot was very common, and there were many cases late in the season. Mosaic, Stripe, and Spotted Wilt occurred, but did little damage. Potato Blight was seen on outdoor plants, but there was much less than last year.

Ring Spot on Lettuce grows more troublesome every year, especially in Cornwall, where there were several cases of serious loss in fields that had never grown lettuce before. The damage done by the disease depends a good deal on the fertility of the soil, a rich, well-balanced soil being the ideal to aim at. Potash dressings will probably play an important part in the control of the disease. Bacterial Leaf Spot occurred in the autumn of 1932, but not much damage was done. Grey Mould is often troublesome under glass. A case of total loss occurred in one house when about half of the crop had been picked. The house was heated through an error, and the plants wilted. Watering was necessary and the conditions thus became favourable to the fungus which attacked the base of every plant, causing them to collapse.

Broccoli diseases were below normal. Ring Spot was observed for the first time in quantity on Roscoff varieties at Braunton. The seed had been raised outside S.W. England. Plants from seed saved in Devon were quite free. Stem Rot (Canker) was observed on seed crops in Devon. On Brussels Sprouts there were several cases of locally severe attacks of Ring Spot and of White Blister.

Rust was abundant on Spinach Beet at Penzance without doing damage.

Pea diseases were rare. Foot Rot was observed for the first time in kitchen gardens in Devon associated with eelworms, *Heterodera Schachtii*, in each case.

Stored onions at Newton Abbot suffered serious loss from Neck Rot (*Botrytis Allii*). There had been previously a slight attack of mildew, and sufficient care had not been taken at harvesting and the store was not suitable.

**FRUIT.**

American Gooseberry Mildew was less serious than usual. It appeared in the Tamar Valley about April 29th, but made little progress in most districts until after the fruit had been picked.

Apple Scab was bad on susceptible varieties, but scarce on the resistant kinds such as Bramley's Seedling and Royal Jubilee. As a whole it was much less severe than last year, but more common than might have been expected from the weather experienced. Perithecia on decayed leaves were uncommon, and the ascospores observed were immature, even at the end of

April. Apple Canker was common through the winter and spring, and even more enquiries than usual were received. Mildew was not serious, generally about normal. Blossom Wilt was frequent, but less than in 1933. Leaf Scorch was less prevalent than usual. Bud Rot caused some loss in Devon, in the early spring, particularly on the variety Grenadier. *Fusarium fructigenum* was isolated in each case. Brown Rot was much less common than usual, but a good deal developed in store.

Pear Scab was common as usual. An interesting observation was made in a garden in Devon. One half of a large wall-tree was protected by a glass shade and was entirely free from Scab. The other half left unprotected was badly attacked by Scab, and the leaves were smaller and the fruits less numerous, in spite of receiving a pre-blossom lime-sulphur spray, which was not given to the protected half. The variety was Pitmaston Duchess. The provision of protection is then a valuable method of controlling Scab in wall trees. The commercial control of Scab by spraying was found near Exeter to be very much more efficient than by dusting.

Plum Rust was frequent, but Wither tip was absent and Brown Rot was very scarce. Black Currant and Gooseberry Leaf Spot was plentiful in August and September.

Cane Spot (*Plectodiscella veneta*) was remarkably abundant on Raspberries and Loganberries; in many cases the fruit was affected and also many of the new canes. Raspberry Rust was scarce.

Strawberries suffered little; Leather Rot did not appear, and the Leaf Spots and Mildew were frequent, but less than usual. Mildew was first noticed on Royal Sovereign on June 8th.

**FLOWERS.**

The mild, dry spring brought about a record flower crop, and the minimum amount of fungal disease. West Cornwall completely escaped Tulip Fire, even second year beds giving healthy flowers, which has never before been experienced. Some damage was suffered in Devon on those farms where the flowers were nearly ready for picking when misty wet weather prevailed on April 23rd, 24th and 25th.

There were many complaints about the condition of Dutch Iris bulbs imported in 1932, *Penicillium* sp. being commonly present. Growth in the spring was satisfactory, however. Iris Leaf Spot (*Heterosporium gracile*) was rather late in appearing; it did no damage in Devon, but became severe in many localities in Cornwall. No control was obtained by spraying. Owing to the low prices many fields were left unpicked. The Ink disease

(*Mystrosporium adustum*) was widely distributed, but the damage was not serious.

Narcissus diseases were all below normal. White Mould appeared on Golden Spur in Penzance on February 20th. It made very slow progress in March and April, and although widely distributed in Devon in May very little loss was sustained. *Stagonospora Curtisii* was common, but did no damage, and *Botrytis narcissicola* was also less common than last year. *Botrytis polyblastis* was not observed. Yellow stripe was less serious than before ; the symptoms were very variable and there were cases of apparent recovery from the previous season.

Arum Leaf Blotch (*Phyllosticta Richardiae*) was common in cold greenhouses, but was easily controlled by lowering the humidity.

The winter scorching of Anemones was again troublesome in Cornwall (compare Ninth Annual Report, p. 25). Mildew is common on Marigolds (*Calendula*) in Cornwall, but is readily controlled by dusting with sulphur. Sooty Mould (not yet identified) was troublesome on Winter Heath (*Erica lusitanica*) in Cornwall in the autumn of 1932. Black Leg in Asters is very common in gardens in South Devon. Downy Mildew of Wallflowers was rather common but not serious.

Chrysanthemum Rust was very prevalent this year, and Snapdragon Rust (*Puccinia Antirrhini*) was observed at the end of the summer in two localities in South Devon. This is the first record for Devon and Cornwall.

# Potato Blight and the Weather.

In previous Reports the weather preceding Potato Blight in each season has been investigated, and the following rules arrived at as indicating conditions favourable to blight, the rules being expressed in a form applicable to the local meteorological data.

(1). Dew observed either the night before or in the morning.
(2). Minimum temperature 50°F. or above.
(3). Sunshine less than 5 hours.
(4). Rainfall at least 0.01 inch.
(5). Relative humidity at 3 p.m. not less than 75%.

The dates on which the above conditions were fulfilled in 1933 at Seale-Hayne College are set out in the following table :—

| Month. | Rule. | Days. |
|---|---|---|
| May | 1 | 1, 10 11, 12, 15, 16, 17, 18, 24. |
| | 2 | 23, 23, 31. |
| | 3 | 2, 3, 4, 5, 6, 7, 8, 10, 12, 13, 20, 22, 28, 30, 31. |
| | 4 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 25, 26, 31. |
| | 5 | 1, 2, 3, 4, 6, 8, 13, 18, 20, 31. |
| June | 1 | 5, 6, 7, 8, 12, 26, 28, 29, 30. |
| | 2 | 1 to 11, 14 to 17, 19, 24, 26, 27, 29, 30. |
| | 3 | 1, 2, 13, 19, 20, 22, 23, 24, 25. |
| | 4 | 1, 2, 3, 9, 12, 13, 18, 20, 21, 22, 23, 25. |
| | 5 | 1, 2, 13, 18, 20, 21, 22, 25. |
| July | 1 | 1, 2, 3, 4, 18 to 26, 29, 30. |
| | 2 | 2 to 31. |
| | 3 | 6, 7, 8, 10, 11, 13, 15, 17, 18, 22, 31. |
| | 4 | 6 to 15, 18, 28, 29, 30. |
| | 5 | 8, 11, 13, 15, 17, 18, 19, 28. |
| August | 1 | 3, 4, 18, 24 to 30. |
| | 2 | 1 to 16, 18 to 21, 23 to 31. |
| | 3 | 10, 11, 13, 14, 15, 17, 19, 22, 24, 29. |
| | 4 | 9 to 15, 17, 19 to 23. |
| | 5 | 11, 13, 14, 15, 17, 22, 24. |

The only date conforming to every rule is July 18; it is probable, however, that all the nights of dew are not recorded as the sun would evaporate it early in the morning in the later months. Also from the point of view of blight considerable rainfall may be as effective as dew if the leaves are wet. If we therefore run Rules 1 and 4 together we get the following days to conform: May 31, June 1, 2, July 8, 11, 13, 18, August 11, 13, 14, 15. The first favourable period at the beginning of June was not followed by blight as warm, dry weather prevailed all the month except for a few days between the 20th and the 25th. Even in this period the conditions were not favourable, as the humidity, as shown by a continuous recording hygrometer placed in the potato plot, was never high all day except on the 1st and 2nd of the month. The next period was more favourable, and humidity was high all day on July 8, 11, 13, 17, 18, 19. Blight broke out in many places in Devon between the 15th and the 20th, and at Seale-Hayne on the 29th. Conditions in August were never very favourable (high humidity all day only on the 15th), and blight generally made very slow progress.

1933, then, was a season in which the epidemic was slight, but the results from forecasting are equally good on the whole as for other seasons. Spraying for blight should have immediately followed the dates July 8, 11, 13, and would then be in time to catch the outbreak. A second spraying just after the July 17 to 19 period would be all that was necessary.

The humidity data for the season clearly correspond to the unusually slight nature of the epidemic. The following table shows the number of days high humidity (from the continuous recording hygrometer) in 1933 and in the bad blight year of 1931 for comparison.

| | 1931 | 1933 |
|---|---|---|
| May | 14 | 7 |
| June | 14 | 2 |
| July | 15 | 6 |
| August | 16 | 1 |

The next table gives the average afternoon (15h.) humidity for each month.

| | 1931 | 1933 |
|---|---|---|
| May | 74.7% | 67.7% |
| June | 76.6 | 67.4 |
| July | 76.4 | 67.7 |
| August | 74.5 | 62.5 |

Blight first appeared in West Cornwall on May 7th. The conditions preceding the outbreak cannot, unfortunately, be investigated on the same lines as for Seale-Hayne, as the afternoon humidities are no longer observed at the Gulval Station. The nearest available data, viz., the 1 p.m. readings at the Lizard, have been examined by kind permission of the Director of the Meteorological Office, but are not a satisfactory substitute, as the Lizard is a coast station very liable to mist and fogs, so that the humidities are probably higher than at Gulval. From April 23 to May 14 the 3 p.m. humidity was 75% or over every day at the Lizard, and as on most days it was in the neighbourhood of 90% it is very probable that the Gulval readings were not less than 75% on those days. For the corresponding period at Seale-Hayne the humidity was high on every day except April 27 and 29 and May 5, 9, 10, 11, 12, 14. The readings at Seale-Hayne for April 30 to May 4 were 87, 81, 99, 85, 93% respectively, which would be very favourable to blight if the temperature was high enough. The air minimum temperatures for Gulval and Seale-Hayne are compared in the following table.

| | Gulval | Seale-Hayne |
|---|---|---|
| 30 April | 44°F. | 37°F. |
| 1 May | 50 | 45 |
| 2 ,, | 50 | 47 |
| 3 ,, | 50 | 49 |
| 4 ,, | 51 | 49 |
| 5 ,, | 51 | 48 |
| 6 ,, | 49 | 49 |
| 7 ,, | 48 | 47 |
| 8 ,, | 50 | 44 |

During April the Gulval minimum differed very little from Seale-Hayne, but the above table shows a constant critical difference for the first week of May.

In 1933 the outbreak of blight, therefore, followed exactly the combination of adequate temperature and humidity and the behaviour corresponds very closely to that of 1932, reported in the Ninth Annual Report.

# Control of Finger and Toe by Liming.

In the Ninth Annual Report, pp. 34-35, it was shown that the Finger and Toe disease in swedes and turnips can be satisfactorily controlled by applying either quick lime or hydrate of lime to the soil and working it in immediately. Satisfactory control was again obtained at two centres in South Devon in 1933. At Farm A 1 cwt. ground burnt lime was spread over one-eighth acre in a two acre field known to be infected with the disease, and at Farm B 1 cwt. of hydrated lime was spread over one-tenth acre in a similar field. Soil samples were taken before the lime was applied, and when the crop was examined for the presence of the disease. The analyses are as follows:—

| | Date collected. | p.H. | Available Phosphate. | Available Potash. |
|---|---|---|---|---|
| **A.** | Before liming 19 June, 1933 | 5.66 | .024 | .018 |
| | Limed plot 25 Oct. ..... | 7.02 | .022 | .009 |
| | Unlimed 25 Oct. ..... ..... | 6.35 | .023 | .015 |
| **B.** | Before liming 20 June ..... | 5.85 | .020 | .016 |
| | Limed plot 25 Oct. ..... | 6.76 | .019 | .015 |
| | Unlimed plot 25 Oct. ..... | 6.14 | .021 | .010 |

On Farm A Marrow Stem Kale, Bruce Turnip and another variety of common Turnip were grown. Kale was healthy throughout, but both turnips were badly attacked, except within the limed plot, where they were free from the disease. The weed, Sheep's Sorrel, was abundant in the field, confirming the low state of fertility shown by the analyses. On Farm B the swedes Balmoral and King of the West were grown. The disease was plentiful, though not severe, and the two varieties were equally attacked. On the limed plot, which included both varieties, only one diseased root could be found.

It will be noticed that the liming raised the pH figure in each case above the figure 6.6. which is probably to be regarded as the limit for the finger and toe disease. Another field on Farm B, which showed the disease in Bruce turnips, had a pH figure of 6.05. On the other hand, another field on Farm A developed the disease in swedes and turnips very badly indeed, in spite of the application per acre of 1 ton of burnt lime siftings three months before sowing and of 6 cwt. Kainit. The pH figure on October 25th was 6.88, so presumably the amount of lime was adequate. The only suggestions that can be made as an explanation is that possibly the lime did not get down into the soil in an active form, or that the soil was exceedingly badly infested.

# Fungal Diseases of Devon and Cornwall.

The following are additions to the Lists of Diseases given in previous Annual Reports.

## I.—DISEASES FOUND IN BOTH COUNTIES.

**CEREALS.**

**Barley.**
Leaf Stripe (*Helminthosporium gramineum* Rab.)

**VEGETABLES.**

**Lettuce.**
Ring Spot (*Marssonina panattoniana* Berl.)

**Tomato.**
Spotted Wilt (Virus).

**FRUIT.**

**Black Currant.**
American Gooseberry Mildew (*Sphaerotheca mors-uvae* Berk.)

**Gooseberry.**
European Mildew (*Microsphaera Grossulariae* Lèv.)

**FLOWERS.**

**Snapdragon.**
Shot Hole (*Heteropatella Antirrhini* Budd. and Wakef.)

## II.—DISEASES FOUND ONLY IN DEVON.

**ROOT CROPS.**

**Turnip.**
White Blister (*Cystopus candidus* de Bary.)

**PULSE.**

**Runner Bean.**
Halo Blight (*Bacterium Medicaginis* E. F. Sm. var. *phaseolicola* Link. and Hull.)

**Pea.**
Foot Rot (*Fusarium Martii* Appel and Wr.)

**VEGETABLES.**

**Broccoli.**
Canker (*Phoma Lingam* Desm.)

**FRUIT.**

**Raspberry.**

Mildew (*Sphaerotheca Humuli* (DC.) Burr.)

**FLOWERS.**

**Snapdragon.**

Rust (*Puccinia Antirrhini* Diet. and Holw.)

Wilt (*Verticillium* sp.)

**Freesia.**

Mosaic (Virus).

**ORNAMENTAL TREES.**

**Box.**

Rust (*Puccinia Buxi* DC.)

**Cupressus macrocarpa.**

Sooty Mould (*Dematium pullulans* de Bary.)

**Euonymus japonicus.**

Root Rot (*Armillaria mellea* (Vahl) Fr.)

**Privet.**

Root Rot (*Armillaria mellea* (Vahl) Fr.)

## III.—DISEASES FOUND ONLY IN CORNWALL.

**PULSE.**

**Dwarf Bean.**

Anthracnose (*Colletotrichum Lindemuthianum* Bri. and Cav.)

Halo Blight (*Bacterium medicaginis* E. F. Sm. var. *phaseolicola* Link. and Hull).

Foot Rot (*Fusarium* Martii Appel. and Wr. var. *Phaseoli* Burkh.)

**VEGETABLES.**

**Spinach Beet.**

Rust (*Uromyces Betae*) (Pers.) Tul.)

**FLOWERS.**

**Marigold.**

Smut (*Entyloma Calendulae* de Bary)

# Seale-Hayne College Pamphlets.

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Pamphlet 3. The Charlock Danger.
" 4. The Feeding of Cows in Relation to Milk Production.
" 5. Plants Poisonous to Stock and First Aid.
" 6. Tariff of Analyses.
" 7. Field Experiments for 1922. (Out of Print).
" 8. Simple Farm Book-keeping for Income Tax Purposes. (Out of Print).
" 9. Feeding Potatoes to Pigs.
" 10. First Report on the Cost of Food in Milk Production in Devon and Cornwall (Out of Print).
" 11. Milk Tainting Plants and Some Stored Milk Troubles.
" 12. Second Report on the Cost of Food in Milk Production in Devon and Cornwall.
" 13. Variety Trial with Oats.
" 14. Spotted Medick.
" 15. Potato Variety Trials, 1924.
" 16. First Annual Report of the Department of Plant Pathology.
" 17. Cost of Milk Production. (3rd Report). (Out of Print).
" 18. Potato Variety Trials, 1925.
" 19. Second Annual Report of the Department of Plant Pathology.
" 20. Potato Variety Trials, 1926.
" 21. Third Annual Report of the Department of Plant Pathology.
" 22. Purity of Strain in Red Clover.
" 23. Economic Investigation of Devon and Cornish Farms.
" 24. Variety Trials with Potatoes. Four years. (Final Report). (Out of Print).
" 25. Fourth Annual Report of the Department of Plant Pathology.
" 26. Grassland Management. (Out of Print).
" 27. Report of Advisory Departments.
" 28. Tables of Composition, Nutritive and Manurial Values of Food.
" 29. Report on the Elimination from a Dairy Herd of Cows re-acting to the Tuberculin Test.
" 30. Fifth Annual Report of the Department of Plant Pathology.
" 31. Sixth Annual Report of the Department of Plant Pathology.
" 32. The Manufacture of Butter.
" 33. Sugar Beet Costs in Devon and Cornwall.
" 34. Guide to Exhibit at the World's Poultry Congress (1930).
" 35. Clotted Cream.
" 36. Seventh Annual Report of the Department of Plant Pathology.
" 37. Eighth Annual Report of the Department of Plant Pathology.
" 38. A Study of Livestock Movements in Cornwall and Devon.
" 39. Bacillary White Diarrhoea of Poultry.
" 40. Ninth Annual Report of the Department of Plant Pathology.
" 41. Labour Requirements of Crops and Stock in the South-West.

W. HENDERSON HOGG,
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April, 1934.